This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

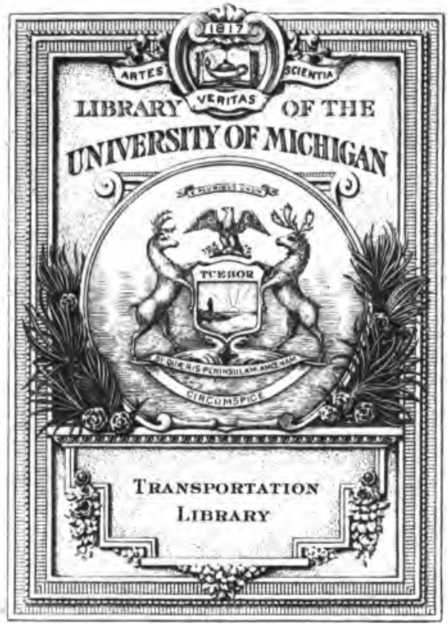
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`



LIBRARY OF THE
UNIVERSITY OF MICHIGAN

TRANSPORTATION
LIBRARY

Transportation
Library
TE
144
.E78

AN

ESSAY

FOR THE

CONSTRUCTION

OF

ROADS

On Mechanical and Physical

Principles.

LONDON:
Printed for T. DAVIES, in Great Ruſſel Street,
Covent Garden.

M,DCC,LXXIV.

Transport.

TE
144
.E78

Trans v.
Cancel
1-19-48

10-15-48 D.R.

PREFACE.

To Mr. DAVIES, *Bookſeller, in Ruſſel-Street, Covent-Garden.*

SIR,

ELABORATE *Preſaces are often like a fine Sign to a bad Inn: Such ſhall not be mine: All I will ſay is, that the following Diſcourſe is upon a Subject which, though in univerſal Practice, has not yet, I believe, been reduced to firſt Principles, and treated in a philoſophical Way. 'Tis the Production*

duction of an ingenious Friend of mine, who wiſhes to throw in his Mite to the public Good, independant of the Views of either the Fame, or the Profit, of Authorſhip: The Concealment of his Name proves the One; you can vouch the Other. Print it as ſoon as you pleaſe; and if the Profit pays your Trouble, it will give him an additional ſatisfaction, as well as,

SIR,

Your Friend,

And humble Servant,

Æ

LONDON,
Mar. 1, 1774.

ESSAY

On the CONSTRUCTION of ROADS.

WHEN the Subject of a Road is treated of, it ought to be underſtood, to be under two diſtinct Heads, *viz.* that of the *Foundation* part; and that of the *Superſtructure* or Covering. The former includes the intended Line of Road, with the ſide Trenches, and under Drains, with the Surface made equal. The latter;

Subſtances of the Stone Kind, &c. laid on, ſo as to conſolidate and render it fit for travelling on.

There is ſcarce a Doubt, that the Conſtruction of a Road, muſt depend on mechanical and phyſical Principles. Whether it has been hitherto viewed in this Light, has not come to my Notice. The public Utility of the Subject, aſſuredly demands Inveſtigation. *Road making* ſeems to be far from ſo ſimple an Operation, as it is oft imagined; too many Teſtimonies there are, to evince this; it is complicated. To bring it to perfection, requires (as all other Arts do) the Aid of Science, to diſcover Cauſes and Effects; that wide extended

Range of Ideas ; that Propriety, Diſcernment and Taſte, which ariſe from a liberal Education.

It is with Diffidence, as well as Deference to ſuperior Abilities, that I have ventured to make a few curſory Obſervations ; merely with the View of rouſing the Attention of thoſe, who are much more qualified to diſcuſs the Subject in a maſterly Manner, and to draw it out into ſuch plain practical Rules, as may be accommodated to the Capacities of thoſe, who are little verſed in higher Speculations. I ſhould even be happy to find my Conjectures diſproved ; and Hypotheſis more rational and juſt, ſubſtituted in their Room.

ACTION *and* RE-ACTION *are equal and contrary.*

On this Axiom, reſts the Idea of a perfect Road. It is obvious, that a well conſtructed Road muſt be framed ſo as to have the Preſſure and Reſiſtance of it's ſeveral Parts to counteract, to counterpoiſe, and to unite in one compacted Body.

From this Outline, we ſee it's Reſemblance to the Properties of the Section of an Arch; where, conceive right Lines proceeding from the Periphery to unite in one common Centre; and each Line is perpendicular to it's reſpective Surface.

Rays of Light paſſing through a convex Lens, and converging in a Focus, may at one View, exhibit a Picture of this.

Imagine this Repreſentation to be a Machine of Timber. The Laws of Gravity, are perfectly kept up, in the Weight being perpendicular; and the Union at the Centre (a firm Baſe, and ſide Supports ſuppoſed) conſtitutes a Reſiſtance, equal to the incumbent Preſſure on the Arch; together with all the Powers above recited, of a proper conſtructed Road.

An Arch of Stone, whoſe Materials are properly adjuſted in their Shape, preſerves the like Powers, on the ſame Principles.

The Above is the moſt ſtable Form, when the conſtituent Parts are large, and put together in a regular and artificial Manner; but in a Road where the various Parts are ſmall and irregular, they are prone to yield, and leave the right Line of Direction; one Part, by giving Way, quits the Perpendicular; makes a lateral Preſſure, and affects the whole.

This elevated Form, both from the Laws of Mechaniſm, and being improper for the Uſes of a Road, is to be laid aſide; and another of a leſs critical Shape muſt be choſen; ſuch as the Section of an Ellipſe. Nay, admitting the Surface of a Road to be very little more than rounded (as is oft found eligible) nevertheleſs, taking in the Foundation; it is preſumable, the whole Strength and Stability will depend on the Principles of an Arch.

To illuſtrate this,—Put a little Ball into a Veſſel with a narrow turned-up Edge or Brim, and immerſe ſo much of it in Paſte, or any other thick Conſiſtance, as will keep it upright; preſs the upper Surface of the Ball, in a Space of about ninety Degrees, with a concave Body to anſwer the Shape of it; and the whole Preſſure will be found as perpendicular in one Point, on the oppoſite Side or Pole of the Ball: So far this agrees with the aforeſaid Definition of an Arch. Take as many of theſe Balls, as will fill the Veſſel, or riſe above the Level; give uniform Compreſſion to the whole Surface of them; they will then combine together; and from a perpendicular Power, (ſupported by a lateral Aid of Preſſure and Reſiſtance from the Bottom) they will unite as ſo many joint Arches, and form a ſtable Counterpoiſe, and act as one ſolid Body; Action equal to Re-action; one Power ballancing another.

Suppoſe a Road to be covered entirely with Gravel, theſe Pebbles are generally found to be of a globular or roundiſh Figure: Such, having their Interſtices fitted with a finer Gravel or Sand, as alſo Earth, will all (when oppoſed or hemmed in, by the out Verge of the Road) act together, and combine, like the Balls, *&c.* in one general uniform Maſs, upon the Principles of a regular conſtructed Arch, though not ſo mathematically juſt; and it will be leſs ſo, where the Gravel has too much Earth in it; or when it is made with Stones, which muſt be angular though ever ſo finely broke.

It might be further aſſerted, that the Failure or breaking up of a Road, is chiefly owing to a Deviation from the above Principles of an Arch. To reaſon on this Head, is unneceſſary; reverſe the Rules of juſt Proportion, and it appears obvious.

So much, it is preſumed, will ſuffice to throw ſome Light on the Point aimed at.

In the Structure of a Road, peculiar Attention is to be paid to the Foundation Part; here muſt lie that Counterpart, that uniform proper Reſiſtance which is to ſupport the upper Fabrick. The Diffirence of Soils is to be carefully examined; what their various Qualities, and by what Meaſures the propoſed End may be gained; having this for ever in your eye; that the Denſity and Elaſticity of *this* Part, muſt correſpond with the other or *Superior*.

When a Road is to be made with Accuracy, it ought to be firſt (as the Term is) *formed*; that is, it ſhould have proper ſide and under Drains made; and the Earth which has been employed in Vegetation, as much ſtript off the Surface as may be convenient, made even, &c. and in this State, ſhould remain ſome time to drain, and ſubſide, and each Part to find it's proper Gravity and Poiſe, before the other Materials are laid on. How long it is to continue uncovered, muſt depend on the Nature and Texture of the Soil, and the Seaſon of the Year, &c. for Inſtance, if it ſhould be a Clay: this Subſtance is very tenacious and coheſive, not ready to take in Water, and averſe to quit with it; and for theſe Reaſons, has a native Spring and Elaſticity, beyond any other. It ought to be no further drained than to take off the ſuperfluous Wet, which elſe would undermine it, would carry away part of that viſcid Subſtance, and leave empty Spaces in it, which would in Time, occaſion the Surface to fall in, and of Courſe the upper Materials. If expoſed too long to the Air before covered in, Draught and Sunſhine make partial Coheſions and the Clay ſeparates; and into theſe Chaſms future Rains enter. From the vitriolic Acid this Subſtance abounds with, it attracts the Salts from the Atmoſphere, together with the finer Particles of Earth mixed with Rain and Dews. A Quantity of Air it is replete with, which was formerly in a fixed State, and ſurrounded by thin Caſes of Clay, forming ſo many native Springs, now expands violently, and like ſo many little Mines tear the exterior Matter to pieces.

From all theſe Reaſons, it would ſoon become of a fertile Nature, and rendered leſs fit for the Purpoſes of a uniform compacted ſpringy Body, able to bear up againſt the incumbent Arch of the Road.

Should the Soil be of any of the rich Loams. Such have but little native Spring in them, and are rather unfavourable; but to remedy this Defect, let the intended Line be ploughed ed or dug; and when the Drains, &c. are made, give it a thin Coat of a fine homogeneous Subſtance, ſuch as Sand: here the Denſity is proportioned, and the Preſſure of it equal; the Sand will incorporate with the Earth, will abſorb riſing Moiſture; and on being rolled, will form a pretty conſiſtent Foundation for the upper Covering of Gravel.

If a gravelly Bottom is found, the Buſineſs is half done, a natural Arch is already found to place the others on.

When Moſs Bog is in the intended Line of Road, and too deep to be removed, the Drains muſt be cut ſo deep as to drain off all the ſuperfluous

Wet from below the very Foundation; when the Moſs muſt be allowed Time to ſubſide, before the upper Part is begun to be made; it has generally a tough Kind of matted Surface, formed by the Roots of Plants, which grow from Earth and Salts, collected from Rains and the Atmoſphere; if on this Maſs, Sand or fine Gravel is laid, it will have a like ſalutary Effect, as in the former Caſe of Loams: Boughs of Trees are expenſive, and are unfit for a great Repair of heavy Carriages. Being left too long uncovered it will turn too dry, and have it's elaſtick repulſive Spring leſſened.

Moſs is a Subſtance of a peculiar Texture, and is generally acknowledged to be compoſed of rotten Vegetables; how it came into this State ſeems not to be intelligibly accounted for, without ſuppoſing it owing to ſubterraneous Collections of Water, whoſe diffuſive Moiſture has (in the Courſe of Ages) cauſed ſuch Changes: on this Preſumption, what Reaſon is there to guard againſt a latent Enemy by deep under Drains? Theſe rotted Vegetables ſeem to retain the heavy eſſential Oil of the denſer Parts of the Plant, together with a fine Earth, from the putrefied Leaves. This Oil is minutely divided and ſurrounded, as in little Bags, by the Particles of Earth and Water to which it ſtrongly adheres, and like ſo many Puff-Balls form a collective Multitude of Springs, all uniting in one elaſtick Body; in this State it reſiſts the Oſcillations of the internal Air, by which it preſerves many Subſtances from Putrefaction: It alſo ſeems to poſſeſs the Power of aſſimilating contiguous Earths into it's own Subſtance; whether they are below its original Bottom, or have fallen on it's Surface, in Rains, &c. from this gradual Increaſe of Bulk, it perhaps may have been ſaid to *grow*, ſomewhat like to Vegetation; Obſerve from this, how ſoon a Road may break down, if Drains are not attended to, and the Surface not frequently repaired.

'Tis granted, that the above Rules (ſuppoſing them to be juſt) cannot be eaſily or minutely executed; nay, from Circumſtances of Want of Time, Seaſons, &c. perhaps not practicable in their full Latitude. The ingenious Artiſt, nevertheleſs, on whatever Subject employed, ought conſtantly to have in his Eye, at leaſt, the ideal Model of Perfection; and in the Execution to come as near it as poſſible; a few Out-lines derived from Truth and Nature being laid down, the Judgment is directed towards certain leading Points; and Diſcretion may (from Neceſſity) deviate prudentially.

The Foundation of a Road being judged ſo eſſential a Part, and it's being feared; ſo often overlooked, occaſioned ſuch a Preciſion of Detail.

It appears a Miſtake to make a Road more raiſed in the Middle, than juſt a little more than will allow the Rain Water to glide gently off the Surface: if raiſed higher, the Water will acquire ſuch a Velocity as to be Superior to the Weight of the finer Gravel, and waſh it down with it into the ſide Trenches; a Deſcent of two Inches to a Mile to enable Water to run, may give it a Sort of comparative Idea, how ſmall a Declivity may anſwer the purpoſe of a Road.

When a Road is raiſed too high, it ſuffers much in Waſte of Gravel from

Wind, ſuppoſing it to blow acroſs the Road, as it aſcends the Ridge it is accumulated; and when reached the Summit, it's Motion is accelerated down the oppoſite Side, and it's Power increaſed, in a Ratio capable of Calculation; and in it's Courſe carries with it the finer and lighter Materials from the Road; and it may be found that on ſuch a Conſtruction, in the Courſe of a Year, the Sides will be lower, in Proportion to the upper Part (even Independent of wearing) than it was in the Beginning. The various Directions of Winds, will have proportional Effects. The Reaſon of this falſe Mould of a Road is pleaded, *to give Allowance for the unavoidable Sinking of the higher Parts.* To this it may be anſwered, that if, after the Foundation is formed, proper Time was allowed, for the ſeveral Parts to ſubſide thoroughly, and to find their reſpective Gravities before the upper Materials are laid on, the future Depreſſions would be but ſmall, and what Parts might happen to fall in, might be eaſily filled up, as they appear; whereas in the former Caſe, if any of the Parts of ſuperior Denſity or of a different Quality, pierce deep into the Foundation, they will there form an unequal ranged Maſs, which perhaps might not henceforward lye in equally poiſed Manner.

Another Objection which ariſes againſt a Road being raiſed high is, that from it's elevated Shape it's Surface, at certain Seaſons, may be too much expoſed to Exhalations, from Sun and Air, and may thereby be too dry: This may occaſion Duſt to riſe, diſagreeable as well as a Conſumption of the Road; ſide Trenches may have a like Effect in ſome Caſes; and back Drains may be more proper.

The Method of forming Roads uſually practiſed, is to dig the Trenches of each Side, and to throw their Contents on the Surface of the Intended Foundation, thereby making it from the Firſt to ſwell and to be Circular. On this they put the covering Gravel, which ſtill makes it

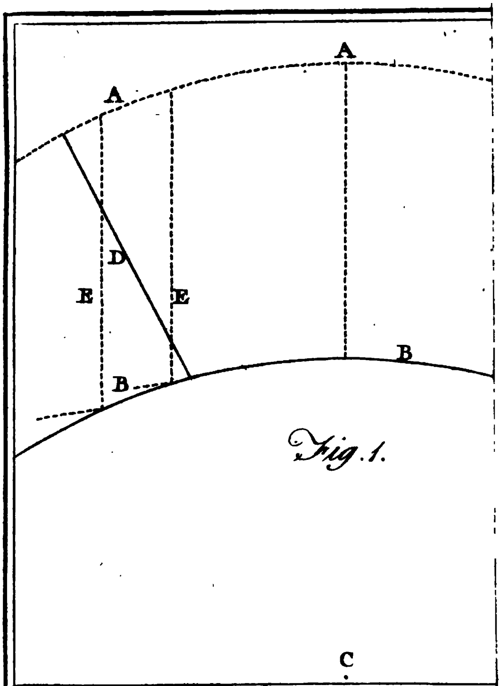


Fig. 1.

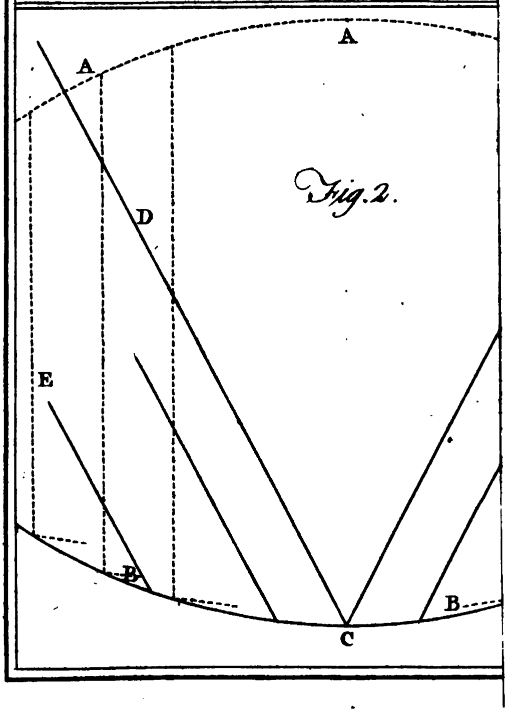


Fig. 2.

more ſo; and, in Fact, joins two Arches one upon another.

A few Obſervations on this Mode, may not be unneceſſary.

It is preſumed, it will be granted, that an Arch formed of various Subſtances, compacted and cemented together, has for it's Center of Gravity the Center of the Circle, of which it is a Section; yet, before the ſeveral conſtituent Parts are joined together, ſo as to act as one Body, each of them muſt retain it's own native Power, and muſt gravitate in the perpendicular Line.

Such is the Situation of a Road newly gravelled and not yet begun to bind; here Nature exerts two different Laws, Gravity, and mutual Coheſion of the Parts, yet diverſe in their Operations; the former in perpendicular Deſcent; the latter ſlow, with a forced Endeavour by Attraction to find out the Center of the Circle. Gravity preponderates, counter-acts the other, and ſtrives to wrench it from it's intended Purpoſe.

This may be more fully illuſtrated from the annexed Draught, Fig. 1. where the dotted Circle AA repreſents the Covering of Gravel of the Road; BB the formed Foundation; C the Center of the Section of theſe two united Arches; DD the Lines proceeding from thence to the Circumference; and EE the Lines perpendicular to the Plane of the Horizon. In theſe perpendicular Lines EE each Particle of Matter muſt deſcend from it's own Weight, till it finds a ſteady fixed Baſe to ſtop it's Progreſs; and theſe Lines are ſeen to deviate from Right to Left, from the Middle of the Road, in Directions different from the Lines DD which terminate in C the Center of Gravity of the Arch A, where the Tendency muſt be, when the attractive Coheſion of the various Parts takes Place.

As it has been ſhewn above, that the Gravel muſt proceed to the Foundation, in Lines towards each Side of the Road, from the Middle of it even from the Denſity of the Parts; it will ſtill continue to move in theſe Directions with more Violence and Velocity, when it comes to be unequally preſſed by Weight. When the Gravel reaches the Foundation (either partially, or in a Continuity of progreſſive Motion) they find it rounded, and the Parts fall upon a circular inclining Baſe, in an oblique Angle, and are ſtill more forced towards the Edges of the Road; and partly muſt be thrown into the Ditches, whereby the Road is robbed, and alſo hindered from binding; the perpendicular Gravity, and the coheſive Search after the Center of the Arch, being counteractive Propenſities, may perhaps, for ever deprive the Materials from finding their proper Place of Reſt; they lie open to Rains, and each Side moulders away, only leaving the middle Part ſtanding up with a high Back.

As the Surface of a Road muſt be ſomewhat rounded to throw off the ſuperfluous Wet from Rains; and ſince ſuch untoward Conſequences ſeem to follow from the Manner of forming as above deſcribed; it appears agreeable to the Laws of Nature to have an opponent Power which may divert theſe, and by a contrary Exertion to conſtitute another, which may not only prevent the Parts from aſſuming a wrong Bias, but will even incline them towards the Center of coheſive Gravity.

Suppoſe, that whatever is the Curve of the Surface of a Road, a ſimilar inverted Curve is made in the Foundation Part lying under it. The Effects will be, as the following Sketch exhibits, Fig. 2. where AA repreſent the Surface of the Road gravelled; BB the Foundation; C the Center of the Circle; DD Lines proceeding from thence to AA; EE Perpendiculars to the two Planes of the Arches AA BB.

Were ~~denſe~~ elaſtick Bodies ſuppoſed to fall with Velocity in the Directions

EE upon an inclined Segment of a Curve equally to B, they would recoil from thence, in Angles proportionate to the Angles of Incidence. Such is not aſſerted to be preciſely the Conſequence of a Quantity of mixed Matter deſcending by it's own Weight: Yet aſſuredly, when this Matter is impelled by Preſſure, (as by Repair of Carriages, &c. on a Road) and meets with Reſiſtance from the Foundation, it muſt endeavour to recoil and leave the perpendicular Direction.

The Tendency of this new acquired Motion will be towards the central perpendicular Line of the inverted Arch; the two diverging Directions of Gravity, and of the Tendency to the Center of the Arch, will now both conſpire in the Purpoſe demanded; the whole Maſs of Matter of each Side will be forced inwards to the Center; as it will be hemmed in, by the circular Declivity of the Sides of the Foundation, and compact the various Parts of the Road into one united ſolid Body; and the more it is occupied in dry Weather, the ſooner will this be effected.

It may not be improper to mention, that for the ſake of more obvious Demonſtration, the Road has been repreſented in the above Draughts, to be the Section of a perfect Circle; in which the oppoſite Powers and Propenſities of Matter muſt act with the wideſt Difference; ſtill as the Surface of a Road muſt be ſomewhat circular or ſwelling, the Conſequences muſt be ſimilar, though in a leſs Degree, as they approach nearer to a flat Surface. The Materials of the Gravelling Part, are alſo ſuppoſed be homogenious, and to act as complete Spheres in an uninterrupted Courſe. Though theſe Circumſtances can never happen literally; yet, it became neceſſary to conceive them ſo, in order to inveſtigate the great Out-lines of the Properties of Gravity, &c. Gravel, though generally not perfectly round, will however act comparatively ſo, and may be fairly reaſoned upon with Allowances.

Let the ingenious Mind trace out the principal Features; theſe it keeps in View, and can apply Reſemblance wherever found. Many may be the Varieties, yet Nature's Laws are permanent and muſt be obeyed; the diſcerning Eye perceives their Energy, though from the narrow Limits of the human Soul, their ſecret Operations and ſpecific Qualities, may be too minute and myſterious for exact Calculation.

It is preſumed, that to an intelligent Obſerver, the Form of a Road deſcribed above, may appear to be (from it's Conſtruction) the moſt ſtable and durable; the Execution is eaſy and ſimple, where the Situation and the Funds anſwer. It may be ſomewhat more Expenſive in making, yet after a Courſe of ſeven Years it may turn out the cheapeſt.

The Coſt alſo may be lightened, provided the neighbouring Farmers ſhould think it their Intereſts, to ſcoop out the valuable Soil from the hollowed Foundation at their own Charges, to make Compoſts, or raiſe Incloſures on the Sides of the Road; it may ſave the Expence too of digging ſide Trenches.

After all it muſt be acknowledged, that as it will require more Gravel than in the common Method; if this ſhould lie at any conſiderable diſtance,

there

there are few public Funds, and fewer public Spirits, that are able and willing to bear, or to riſque the Chance of Loſſes; ſtill the Subject is of that Moment, as to merit an Enquiry into the Practicability on the one Side, and to call forth Exertion on the other.

In difficult and perplexing Situations, Taſte and Intelligence in Nature (as pointed out above) muſt finally direct: Theſe will teach the making the beſt Uſe of ſuch Materials as they can command; they will ſtudy with Accuracy the Diverſities of Soil, and Shape of Grounds they have to deal with; and will avoid ſuch Abſurdities as Ignorance daily furniſhes melancholy Inſtances of: Much Money ſunk, and much bad Travelling.

Gravels and Earths require a certain Degree ot Moiſture, to give them Solidity; it tends to increaſe the Coheſion or Attraction of the Parts, as well as by it's propenſive or repelling Power, to form Reſiſtance againſt Preſſure: Sand in a dry, or in a moiſt State, ſhews theſe different Effects.

If a Road in the Summer Months could be diſſected, it would be found full of Cracks from the unequal Contraction of it's Parts; how weakening is this to it's Fabrick; into theſe Fiſſures ſucceeding Rains enter; and theſe little Baſons are ſeized on by Froſts, and the ſurrounding Parts are rent and crumbled down by Thaws: Whereas, when Drains are properly adjuſted, and the Surface but juſt rounded, the ſuperfluous Water gently falls off, and no more is imbibed than what the Earths naturally lay hold of and can retain; and the Pores are compactly filled, and the entire Stratums, united upon a firm Baſe; and when proper Moiſture is not to be had from the Clouds, it will be drawn up from the Foundation.

To think of making a Road entirely, or any Part of it, of large Stones is an Undertaking contrary to the proportionate Laws of Matter, from whence the above Obſervations are attempted to be deduced; and this from their ſuperior Weight piercing into the Foundation, where there is no adequate Reſiſtance; from their continued Inclination ſtill to deſcend and their never finding that ſelf Poiſe, that counteractive State, ſo eſſential to Duration. They alſo from over preſſing the Bottom-part, force up Water from thence, in ſuch Quantities, as is hurtful to the Binding of the Road, as well as unpleaſant to the Traveller: This has been experienced in Pavements, where the Stones are laid in a Courſe of Sand, but remedied by mixing a little Lime with the Sand with which it unites, and keeps down the riſing Wet. Stones may be found to attract Moiſture of themſelves too, eſpecially if they be what is called *Land Stones.* Even when Stones are broke very ſmall (which is expenſive) their angular Shape cannot coincide with the above eſtabliſhed Principles.

The only Method, any how plauſible, is to hollow out the Foundation of the Road; and in this to build a Layer of Stones in the Form of an inverted eliptick Arch, and to fill this with thoſe, beat fine as poſſible. Theſe two Bodies may form a united Force, (though not a durable one) and may have ſomewhat of the Strength of a *complete* Ellipſe; but this Scheme would coſt ſo much, as to forbid trying it, unleſs from an abſolute Neceſſity; beſides, it is preſumed, that where Stones are, Gravel may not be far off. Perhaps in ſome Caſes it might be found more expedient to have the Foundation formed in a right Angle, or even more acute ones, which might give the upper Materials the Power of a Wedge, and incline the ſuperfluous Wet to ſubſide more eaſily; with other Advantages, which may be collected from Hints.

But theſe, with various other Experiments, ought firſt to be tried on a ſmall Scale, ſuch as in gravel Paths in Pleaſure Grounds; where at a trivial Expence, the Properties and Powers of Matter might be aſcertained.

The minute Particles of different Subſtances, generally poſſeſs different Powers of Attraction towards each other; they will quit the weaker and fly to the ſtronger. Theſe Powers are not only diſcovered in the various Solutions, but are likewiſe manifeſt in Bodies in their drier Forms; ſome unite cloſer (and as Road Makers term it) bind harder, Cements evince this; nay, ſtrong Concretions and Putrefactions, in their ſeveral Stages, ſhew this great Work of Attraction to be for ever carrying on in the Bowels of the Earth.

What a Field for Ingenuity may preſent itſelf at a Gentleman's Door, in ſearching into the coheſive Qualities of the many different Kinds of Gravels, Earths, &c. To enquire which of them unite beſt together in all their varied Combinations. To gain ſomething of a Line to walk by, and to be able (from Mixtures) to uſe ſome Ingredients with Succeſs, which in the common looſe Way of Management, are reckoned totally unfit for their Purpoſes.

To point out Probabilities would lead into a large and deep Detail. They will occur to the *Naturaliſt:* To ſuch it might appear impertinent to *others* unintelligible, fanciful or ludicrous.

As rolling ſeems ſo neceſſary for Roads, both in the Courſe of making and in the ſeveral Repairs, as well as to preſerve them in good Order; might not each Pariſh be provided with a Roller, which might be uſed in the proper Seaſons from the Statute Labour?

F I N I S.